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ORIGINAL RESEARCH

ACUTE OUTCOMES OF MYOFASCIAL DECOMPRESSION (CUPPING THERAPY) COMPARED TO SELF-MYOFASCIAL RELEASE ON HAMSTRING PATHOLOGY AFTER A SINGLE TREATMENT

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ABSTRACT

Background: Myofascial decompression (MFD), or cupping, and self-myofascial release (SMR) are common techniques utilized to treat soft tissue injuries and increase flexibility. MFD is a negative pressure soft tissue treatment technique using suction to manipulate the skin and underlying soft tissues. One method of SMR is a foam roller, where a patient rolls his/her bodyweight over a dense foam cylinder in a self-massaging fashion to mobilize soft tissues for the body part treated.

Hypothesis/Purpose: The purpose of this investigation was to examine the acute effects on hamstring flexibility and patient-rated outcome measures comparing two soft tissue treatments, 1) MFD, and 2) a moist heat pack with SMR using a foam roller in patients with diagnosed hamstring pathology.

Study Design: Pilot randomized controlled trial study.

Methods: Seventeen collegiate athletes [13 males (20.6 + /- years; 184.9 + /-cm; 90.8 + /-kg) and 4 females (20.5 + /-years; 167.1 + /-cm; 62.7 + /-kg)] with diagnosed hamstring pathology (mild strain and/or symptoms of tightness, pain, decreased strength, and decreased flexibility) were randomly assigned to receive MFD or SMR. The MFD group (n = 9) received three minutes of static treatment using six plastic-valve suction cups along the hamstrings followed by 20 repetitions of active movement with cups in place. SMR (n = 8) received 10 minutes of heat treatment over the hamstrings followed by 60 seconds of general mobilization over the entire hamstring area, and 90 seconds of targeted foam rolling on the area of most perceived tightness. Passive hamstring flexibility (ROM) and a patient-rated outcome measure [Perceived Functional Ability Questionnaire (PFAQ)] were assessed before and immediately after treatment. The Global Rating of Change measure (GROC) was administered post-intervention.

Results: Passive ROM and subjective PFAQ measures for overall flexibility and flexibility of the hamstrings were significantly different from pre- to post-intervention measurements regardless of the treatment received. A significant difference was found in favor of the MFD group for the GROC values.

Conclusion: The findings suggest that both treatments are beneficial in increasing hamstring length. Patients though felt an enhanced treatment effect using MFD over SMR for perceived benefits to hamstring flexibility.

Levels of Evidence: Level 2

Keywords: myofascial decompression, cupping, self-myofascial release, foam roller, hamstring

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INTRODUCTION

Hamstring injuries are described as the third most common orthopedic problem after knee and ankle injuries, and often have a long recovery time and high risk of reinjury.[1] Hamstring strains have been documented as the most common injury in the Australian Football League[2], the second most frequent injury in the National Football League pre-season camps,[3]and account for 6% of injuries in intercollegiate basketball.[4] In the sport of track and field, hamstring strains accounted for 26% of all injuries sustained, with sprinting events being the most common.[5] In the sport of soccer, a recent systematic review cited that hamstring injuries represent between 15 and 50% of all muscle injuries.[6] Hamstring strain injuries can cause a decrease in overall athletic performance[7, 8] and significant time loss from participation,[2,7, 9, 10] with one study citing time losses between one and seven days for minor injury, eight and 28 days for moderate, and greater than 28 days for severe strains.[8]

A commonly accepted risk factor for hamstring injury is inadequate extensibility within the posterior thigh compartment.[11,12] Incorporating stretching as part of a global aerobic warm-up prior to exercise is thought to decrease passive stiffness and increase range of movement during exercise.[13] It is suggested that static and dynamic stretching before physical activity are equally effective at increasing range of motion and extensibility of the stretched muscle and soft tissues,[13] which may in conjunction with a global warm-up, decrease the chance for musculotendinous injury.[13–17] Flexibility may be hindered by a number of neuromuscular factors including changes in tendon length, length of muscle resulting from elongation and rotation of muscle fascicles, the reflexive passive resistance of the musculotendinous unit, reductions in stretch tolerance, as well as gender and genetic differences.[18] Additional limitations to flexibility include fascial restrictions.[19, 20] Fascia can become restricted due to injury, inactivity, disease, or inflammation,[19] and can lead to decreases in flexibility and increases in pain.[19]

Various techniques of myofascial release are currently being used to alleviate the effects of fascial restrictions, with the purpose of manipulating the fascia to facilitate histological length changes to relieve fascial restriction symptoms such as pain and restricted ROM.[20] This change in state allows for the breaking apart of fibrous adhesions between the different layers of the fascia and restores the soft tissue extensibility.[21] As fascia is disturbed, or begins to move, it becomes more fluid and less viscous, therefore, techniques of myofascial release are theorized to address muscular involvement and the thixotropic nature of fascia to return it to a softer and more pliable state.[21] By releasing its tightness through manual therapy or other techniques, pressure is relieved on these areas and blood circulation becomes normal.[22] Fascia is heavily innervated by sensory mechanoreceptors that when stimulated with manual pressure has shown to lead to a lowering of sympathetic tonus as well as a change in local tissue viscosity.[23] Fascial manipulation stimulates type III and IV fascial sensory nerve endings, which have been shown to induce changes in local vasodilation and changes in muscle tonus by resetting the gamma motor feedback loop to the central nervous system.[24]

Manual therapy is known to alter the tissue tone and also to change the consistency of the ground substance, and therefore likely to affect the mechanical properties of fascia by altering its viscoelastic, shock-absorbing and energy-absorbing properties.[19] The application of self-myofascial release has been shown to address the thixotropic properties of the fascia by increasing blood flow and reducing scar tissue adhesions.[20,25] One self-myofascial release technique that has been shown to increase flexibility prior to physical activity is a foam roller. The foam roller is a dense foam cylinder a patient rolls his/her bodyweight over in a self-massaging fashion to increase ROM for the body part treated. As the individual rolls, the foam roller places direct and widespread compression on the soft-tissue, therefore causing the tissue to stretch and creating friction between the body and the foam roller.[20] The friction causes the fascia to warm and take a more fluid like form, which in turn breaks up the fibrous adhesions that lay between the layers of connective tissue.[21] It is hypothesized that during the rolling, direct sweeping pressure is exerted on the soft tissue lengthening the fascia to stretch and increase ROM.[20] Studies have demonstrated improvements in quadriceps flexibility by 10° after two, one-minute trails of foam rolling.[20] Flexibility as measured by sit-and-reach has improved after foam rolling of the hamstrings and gluteal muscles.[26] Foam rolling has also been found to decrease the perception and feelings of post-exercise fatigue.[27]

One treatment that is becoming more prevalent is myofascial decompression (MFD), traditionally known as "cupping therapy". Cupping therapy is a traditional complementary and alternative medicine technique used for thousands of years in countries such as China, Japan, Korea and Saudi Arabia.[28] Cupping therapy has been proven effective in many kinds of diseases associated with pain, cardiovascular disorders, inflammatory and metabolic diseases,[29] as well as musculoskeletal conditions such as low back and hip pain in soccer players,[30] chronic neck pain[31], pain related to carpal tunnel syndrome.[32] Myofascial decompression, as it is known in current Western medicine cultures, is a negative pressure soft tissue treatment technique utilized to manipulate the skin and fascial tissue. Using suction, the cups have the ability to grab and lift the fascia that may allow for lymphatic drainage of toxins, as well as stretching the fascial tissue.[33] It is suggested that by using the appropriate cup size for the anatomical area being treated, there can be some relief of a deep fascial adhesion and allow for the muscle alone to move free of restriction.[33] Recently researchers have found that cupping therapy could alter skin blood flow[34], change the biomechanical properties of the skin[35], increase pressure pain thresholds in the neck[36] and reduce inflammation.[37] Despite low levels of clinical evidence, MFD is becoming a mainstream intervention for the treatment of musculoskeletal pain and dysfunction in sport. The mechanism of MFD is not completely understood, however some researchers suggest that placement of cups on selected acupoints on the skin produces hyperemia or hemostasis, which results in a therapeutic effect and that cupping therapy is of potential benefit for pain conditions.[38]

Feldbauer et al. recently asserted that self-myofascial release can be beneficial in significantly increasing ROM of the lower extremity;[39] however little is known about the effects of MFD in the rehabilitation of hamstring pathology and its impact in changes in flexibility. Williams et al. found no significant changes in hamstring flexibility after cupping in asymptomatic or healthy individuals.[40] While there is low-level evidence to support the use of self-myofascial release using a foam roller to increase range of motion and flexibility in the lower extremity[39], research is scant regarding the analysis of outcomes of MFD on flexibility and function in patients with hamstring pathology.

To date there are no published studies to validate the effectiveness of MFD on hamstring flexibility. Therefore, the purpose of this investigation was to examine the acute effects on hamstring flexibility and patient-rated outcome measures comparing two soft tissue treatments, 1) MFD, and 2) a moist heat pack with SMR using a foam roller in patients with diagnosed hamstring pathology. The objectives of this study were twofold. The first objective was to determine if an acute bout of MFD is beneficial in improving flexibility and range of motion (ROM) of the hamstrings compared to self-myofascial release using a foam roller (SMR) on patients with diagnosed hamstring pathology. The second objective was to examine patient-reported perceptions of pain, flexibility and impact of a single treatment of MFD on their hamstring. In this study, the term "acute" refers to the time period immediately after treatment. This time point was chosen to demonstrate how MFD could be used to improve symptoms experienced with hamstring pathology.

METHODS

Design

This was a pilot randomized controlled trial study. A convenience sample of collegiate athletes with current hamstring injury were recruited to participate. The independent variables were a single treatment of myofascial decompression cupping therapy, or a moist heat pack with self-myofascial release using a foam roller. The dependent variables were hamstring flexibility, and patient-rated outcome measures of perceived changes utilizing the Perceived Functional Ability Questionnaire, and the Global Rating of Change instruments.

PARTICIPANTS

Seventeen collegiate athletes participating in the sports of football, track, basketball, softball and baseball

[13 males (20.6 + / – years; 184.9 + / – cm; 90.8 + / – kg) and 4 females (20.5 + / – years; 167.1 + / – cm; 62.7 + / – kg)] with symptoms including tightness, pain, decreased strength, and decreased flexibility of the hamstrings voluntarily participated. Eight of the subjects were active in-season, with nine subjects participating in off-season training activities. Subjects were required to have one or more of the symptoms to be included: acute tightness after or during activity, pain, decreased strength, or decreased flexibility. Each subject was evaluated by the same certified athletic trainer for hamstring pathology inclusion. All injuries were acute in nature and diagnosed as having minor severity. Subjects were able to continue with physical activity; however, did not receive any other form of treatment and refrained from strengthening exercise and therapeutic exercise 24 hours prior to the study. This study was approved by the Oklahoma State University's Institutional Review Board for human subject research. Prior to assignment of treatment groups, all subjects signed an informed consent agreeing to participate in the study.

PROCEDURES

Participants who had never received cupping therapy were randomly assigned to one of two intervention groups by coin flip (nine assigned to the MFD group and eight to the SMR group). Due to nature of the independent variables, subjects were not blinded to the intervention applied but received brief instructions and education regarding the application of each respective treatment. Many studies have investigated the benefits of SMR using a foam roller to improve flexibility and range of motion about a joint. Since this modality has been accepted and is widely used as a means of improving flexibility, and with no studies to compare flexibility and outcome changes after MFD, the SMR technique served as the comparison or control for this study. Dependent variables were assessed before and immediately after intervention, taking approximately two minutes to complete. Hamstring flexibility (ROM) was assessed via digital inclinometer (Mitutoyo Pro 360 digital protractor; Andover, UK) secured to the anterior tibia just distal to the tibial tuberosity in a supine straight-leg-raise position.[41] The digital inclinometer has been demonstrated as having excellent validity in measuring range of motion during straight leg raising.[41] Additionally, the digital inclinometer has good inter-rater reliability in studies examining range of motion about the hip (ICC > 0.80)[42] and according to manufacturer specifications, has a maximum error of $\pm$ 0.2°.

Participants were positioned in a supine position on a padded plinth with care taken to ensure consistency in subject positioning (arms crossed, spine in neutral position in the coronal plane, lower limbs in neutral abduction and rotation with the contralateral leg secured to the table with straps). The examiner maintained full knee extension by applying pressure manually to the front of the knee until end range resistance was noted, and was maintained as the leg was passively raised into hip flexion (Figure 1). All passive range of motion assessments were performed by the same investigator who was blinded to seeing the values on the inclinometer during testing. Patient-reported outcomes of perceived function and pain were assessed with the Perceived Functional Ability Questionnaire (PFAQ)[43] and overall treatment effectiveness assessed by the Global Rating of Change Scale (GROC).[44]

Perception of Functional Ability Questionnaire (PFAQ)

The PFAQ contains six critical domains identified for the assessment of functional ability during a functional task: physical health, flexibility, muscular strength, pain, restriction of sport, skill and activity of daily living performance.[43] The instrument was developed by a panel of physicians, athletic trainers, and patients. Internal consistency was assessed

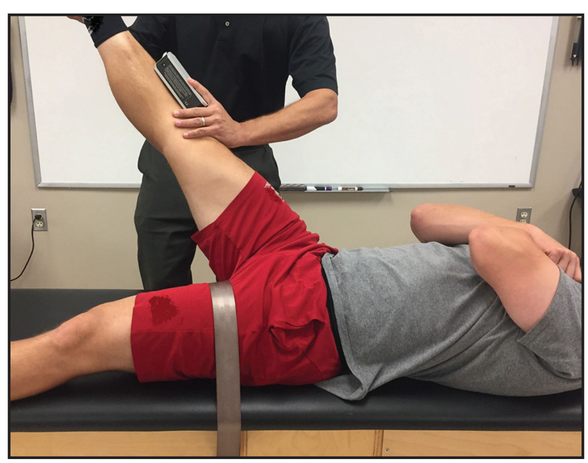

Figure 1. *Hamstring flexibility measurement technique.*

for all items collectively (Cronbach's alpha = 0.856), with a score of 0.8 considered good and 0.9 excellent.

GROC

The GROC establishes the effectiveness of treatments by documenting the patient's improvement or deterioration over time. Subjects were asked to select a phrase on the GROC that best described how they were feeling after their treatment. The scale was designed to quantify a patient's improvement or deterioration over the given time to determine the effectiveness of the treatment based on the perception of the subject.[44] The scale has 15 possible answers ranging from +7 ("a very great deal better") to −7 ("a very great deal worse"), with an option of 0 ("about the same").[45] Jaeschke noted the clinical relevance of the scale, its adequate reproducibility, and sensitivity to change.[44] The minimally clinically important change for the GROC has been established at $\pm$ 4 points.[45]

Figure 3. *Active knee flexion performed by the subject with the cups attached.*

INTERVENTIONS

The MFD group received three minutes of static treatment using six plastic-valve suction cups along the length of the hamstrings (Figure 2), followed by active mobilization consisting of 10 repetitions of full-range active knee flexion with the cups in place (Figure 3) and 10 repetitions of passive straight leg raise with the cups in place to a hip angle of approximately 45 degrees. Participants in the SMR group received 10 minutes of moist heat treatment over the hamstrings followed by 60 seconds of general foam rolling mobilization over the entire hamstring area, and 90 seconds of targeted foam rolling on the area of greatest perceived tightness. Subjects were instructed to apply enough pressure to feel a mobilization of the soft tissue, but not to the point of discomfort (Figure 4). A moist heat pack and foam rolling was chosen because of its common use as a treatment for hamstring injuries in athletic populations.

Figure 2. *Myofascial decompression cups placed statically along hamstring muscle group.*

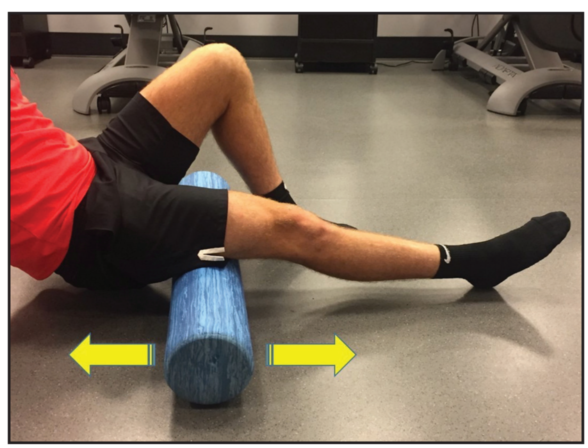

Figure 4. *Self-myofascial release (SMR) foam rolling technique.*

STATISTICAL ANALYSES

Paired sample t-tests were used to compare mean differences in pretest and posttest measures of flexibility (ROM) and each of the PFAQ measures of functional perception. An independent sample t-test was used to evaluate differences in clinical effectiveness (GROC). Descriptive statistics were evaluated to determine outcomes as reported on the GROC. An ANOVA was used to compare differences between the two treatment groups. Effect sizes (ES) for ROM are reported as Cohen's d using the guidelines of small (0.2), medium (0.5), and large (0.8).[46] Effect sizes for the ANOVAs are reported as omega squared values (ω^2) using the guidelines of small (0.01), medium (0.06), and large (0.14).[46] Confidence intervals (CI) at 95% were calculated to assess the magnitude of change for clinical meaningfulness.

The Minimal Clinically Important Difference (MCID) was also assessed for the dependent variables. MCID relates to the smallest change in a clinical outcome measure, which correlates to a person feeling 'slightly better' than the initially recorded state.[47] In research that analyzes the therapeutic benefit of an intervention, the MCID is an important statistic as it separates outcomes into success or failure and represents a level of therapeutic benefit significant enough to change clinical practice.[48] An alpha level of significance was set at 0.05 a priori.

RESULTS

Ten athletes presented with right hamstring pathologies and seven presented with left hamstring pathologies. Table 1 presents the means and standard

Table 1. *Descriptive and Statistical Results (Paired Samples T-Test Overall Model) N = 17.*

Variable	Time	Mean	SD	CI	t	p-value	Effect Size
Passive Range of Motion (degrees)	Pre	74.69	15.96	-6.85, -1.29	-3.10	0.01*	.24
	Post	78.76	17.64				
Overall physical health ‡	Pre	5.47	1.88	-1.08, 0.02	-2.05	0.06	.31
	Post	6.00	1.50				
Overall muscular flexibility ‡	Pre	4.65	1.97	-0.78, -0.05	-2.38	0.03*	.21
	Post	5.06	1.89				
Flexibility of hamstring ‡	Pre	3.00	1.06	-1.36, -0.64	-5.83	0.00*	.85
	Post	4.00	1.28				
Overall muscular strength ‡	Pre	5.88	1.41	-0.65, 0.06	-1.77	0.10	.22
	Post	6.18	1.24				
Strength of hamstrings ‡	Pre	4.18	1.38	-1.01, -0.04	-2.31	0.03*	.37
	Post	4.71	1.45				
Pain in hamstrings ‡	Pre	4.41	1.84	-0.16, 1.10	1.58	0.13	.25
	Post	3.94	1.89				
Effect on sport performance ‡	Pre	5.41	1.66	-0.36, 0.59	0.52	0.61	.06
	Post	5.29	1.86				
Effect on activities of daily living ‡	Pre	2.65	2.21	-0.05, 0.29	1.46	0.16	.05
	Post	2.53	2.27				

* indicates statistically significant difference at p= <0.05.

‡ indicates subjective variables assessed by the Perceived Functional Ability Questionnaire. Subjects rate each variable according to how they feel at that moment in time on a scale of 1-10, where Poor = 1-3; Good= 4-7; Excellent= 8-10.

deviations for all pre and post experimental conditions. Aggregate data showed significant improvements in ROM regardless of treatment ($t = -3.10$, $p = 0.01$, $d = .24$) (Table 1 and Figure 5). Answers to three of the eight patient-oriented questions on the PFAQ were also found to be statistically significantly different between participants (Table 1). Subjects indicated an overall improvement in perceived muscular flexibility ($t = -2.38$, $p = 0.03$, $d = .21$), muscular flexibility of the affected body part ($t = -5.83$, $p = 0.00$, $d = .85$), and an overall improvement in muscular strength of the hamstrings ($t = -2.31$, $p = 0.03$, $d = .37$) regardless of which treatment they received.

Subjects in the MFD group (Table 2) showed a significant improvement in ROM ($t = -3.74$, $p = 0.01$, $d = .28$) while no significant changes were noted for ROM in the SMR group ($t = -1.44$, $p = 0.19$, $d = .19$). The MFD group also demonstrated significant changes in PFAQ measures of perception of overall muscular flexibility ($t = -2.31$, $p = 0.05$, $d = .35$); perceived flexibility of the hamstrings ($t = -5.66$, $p = 0.00$, $d = 1.06$); and perceived strength of the hamstrings ($t = -2.53$, $p = 0.03$, $d = .62$). The SMR group also indicated significantly improved perceptions of hamstring flexibility ($t = -3.42$, $p = 0.01$, $d = .61$).

Between group comparisons showed no differences in ROM between MFD and SMR groups ($F1,15 = .08$, $p = 0.79$, $\omega^2 = -.057$) (Table 3). The only significant between group difference observed was that subjects in the MFD group noted a greater perception of hamstring flexibility according to the PFAQ compared to SMR ($F1,15 = 5.43$, $p = 0.03$, $\omega^2 = .206$) (Table 3 and Figure 6).

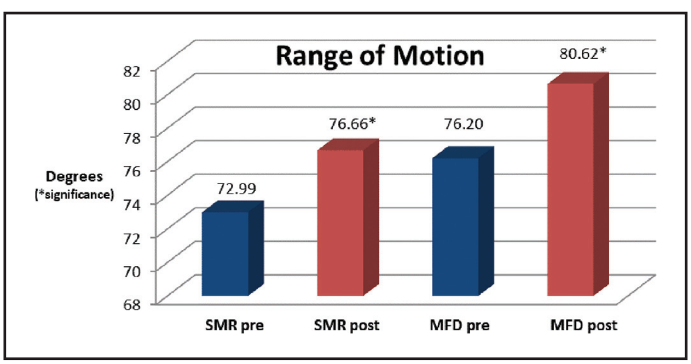

Figure 5. *Hamstring flexibility changes in after self-myofascial release (SMR) and myofascial* decompression (MFD).

Subjects receiving MFD indicated a statistically significant higher score on the GROC compared to SMR ($t = -3.42$, $p = 0.004$, $d = 1.66$). Subjects in the MFD group indicated "moderately better" response to treatment, or a change of +4 points on the GROC scale[44] demonstrating a clinical meaningful change[45] compared to those in the SMR group indicating "tiny bit better" to a "little bit better" (change of + 1–2 scale points) (Figure 7).[44] According to Fritz and Irrgang[45] a clinically meaningful improvement on a 15-item GROC scale requires a difference of ± 4 score points.

DISCUSSION

This is the first study to investigate clinical outcomes of myofascial decompression (cupping) therapy in subjects with perceived tightness and range of motion limitations in the hamstrings. Because of limits in research design and poor research quality, the clinical evidence regarding cupping therapy is very low.[28] Low evidence is available citing that cupping therapy is effective on conditions of herpes zoster, facial paralysis, acne and cervical spondylosis;[38] however, no studies to date have investigated the effects of MFD on hamstring pathology.

Regardless of the treatment, an improvement in hamstring flexibility from pre to post intervention was observed. Hamstring flexibility was improved by an average of 4.42° for the MFD group and 3.67° for SMR. The calculated effect size for ROM in the MFD group was .28, indicating a small magnitude of difference in this significance.[51] This differs from findings of Williams et al.[45] that did not observe significant changes in hamstring flexibility after seven minutes of therapeutic cupping. Potential explanations for the lack of hamstring length improvement is that Williams et al.[45] tested asymptomatic subjects that were otherwise considered healthy. It is possible that greater benefits in tissue motion are experienced after cupping in muscles that have a pathologic condition or fascial adhesions. Additionally, the current study involved both static placement and dynamic movements during the cupping treatment, which may affect fascial tissue to a greater extent than a static placement alone. This bimodal treatment of

Table 2. *Descriptive data, Statistical comparisons (Paired Samples T-Tests) and Effect Sizes for pre- and post- measurements of ROM and Perceived Functional Ability Questionnaire (PFAQ) for both treatment groups. [N = 17, (SMR = 8, MFD = 9)]*

Variable	Group	Time	Mean and SD	Mean diff	SD	CI	t	*p* value	Effect Size
Passive ROM (degrees)	MFD	Pre Post	76.20 ± 15.49 80.62 ± 15.75	-4.42	3.55	-7.15, - 1.69	- 3.74	.01*	.28
	SMR	Pre Post	72.99 ± 17.38 76.66 ±20.45	-3.68	7.22	-9.71, 2.36	- 1.44	.19	.19
Overall physical health ‡	MFD	Pre Post	5.00 ± 1.58 5.88 ± 1.05	-0.89	1.36	-1.93, 0.16	- 1.96	.09	.65
	SMR	Pre Post	6.00 ± 2.13 6.13 ± 1.96	-0.13	0.35	-0.42, 0.17	- 1.00	.35	.06
Overall muscular flexibility ‡	MFD	Pre Post	4.67 ± 2.00 5.33 ± 1.73	-0.67	0.87	-1.33, 0.00	- 2.31	.05*	.35
	SMR	Pre Post	4.63 ± 2.07 4.75 ± 2.12	-0.13	0.35	-0.42, 0.17	- 1.00	.35	.05
Flexibility of hamstring ‡	MFD	Pre Post	3.11 ± 1.17 4.44 ± 1.33	-1.33	0.71	-1.87, - 0.79	- 5.66	.00*	1.06
	SMR	Pre Post	2.87 ± 0.99 3.50 ± 1.07	-0.63	0.52	-1.06, - 0.19	- 3.42	.01*	.61
Overall muscular strength ‡	MFD	Pre Post	5.67 ± 1.73 6.22 ± 1.48	-0.55	0.88	-1.23, 0.12	- 1.89	.10	.34
	SMR	Pre Post	6.13 ± 0.99 6.13 ± 0.99	0.00					
Strength of hamstrings ‡	MFD	Pre Post	4.11 ± 1.36 5.00 ± 1.50	-0.89	1.05	-1.70, - 0.08	- 2.53	.03*	.62
	SMR	Pre Post	4.25 ± 1.49 4.37 ±1.14	-0.12	0.64	-0.66, 0.41	- 0.55	.60	.09
Pain in hamstrings ‡	MFD	Pre Post	4.56 ± 2.00 3.89 ± 2.03	0.67	1.50	-0.49, 1.82	1.33	.22	3.3
	SMR	Pre Post	4.25 ± 1.75 4.00 ± 1.85	0.25	0.89	-.049, 0.99	.80	.45	.14
Effect on sport performance ‡	MFD	Pre Post	5.22 ± 1.98 5.11 ± 2.26	0.11	1.27	-0.86, 1.09	.26	.80	.05
	SMR	Pre Post	5.63 ±1.30 5.50 ±1.41	0.13	0.35	-0.17, 0.42	1.00	.35	.09
Effect on activities of daily living ‡	MFD	Pre Post	3.44 ± 2.40 3.22 ± 2.59	0.22	0.44	-0.11, .056	1.51	.17	.08
	SMR	Pre Post	1.75 ±1.67 1.75 ±1.67	0.00					

MFD = myofascial decompression, SMR = Self myofascial release
* denotes statistically significant difference at $p \leq 0.05$
‡ indicates subjective variables assessed by the Perceived Functional Ability Questionnaire. Subjects rate each variable according how they feel at that moment in time on a scale of 1-10 where Poor = 1-3; Good = 4-7; Excellent = 8-10

cupping also differs from a more static position of the limb that was utilized with the SMR foam rolling. Foam rolling techniques are commonly performed in a static joint position with limited active movements of the joints during the rolling technique. While a significant improvement was observed in the MFD group, the SMR group failed to achieve statistically significant improvements, which could be attributed somewhat to the differences in tissue length created by the active movements in the MFD intervention group compared to a more static muscle length position in the SMR group. Although similar to the present study, Mikesky et al.[49] found no increase in hamstring ROM after two minutes of self-administered roller massager, a comparable action to a foam roller yet a different SMR modality. Additionally, Couture et al.[50] showed no significant differences between baseline knee extension ROM and the ROM present after foam rolling for either a short (2 sets of 10 sec) or long (4 sets of 30sec)

Table 3. *Statistical comparisons between myofascial decompression (MFD) and self-myofascial release (SMR) for ROM and Perceived Functional Ability Questionnaire (PFAQ) subjective measures. [N = 17, (SMR = 8, MFD = 9)]*

Variable	Treatment	Mean differences	SD	95% Confidence Interval	$F_{(1,15)}$	*p-value*	Effect size ω^2
Passive ROM (degrees)	SMR	-3.68	7.22	-9.71, 2.36	0.08	0.79	-.057
	MFD	-4.42	3.55	-7.15, -1.69			
Overall physical health ‡	SMR	-0.13	0.35	-.42, .17	2.35	0.15	.073
	MFD	-0.89	1.36	-1.94, .16			
Overall muscular flexibility ‡	SMR	-0.13	0.35	-.42, .17	2.71	0.12	.091
	MFD	-0.67	0.87	-1.33, 00			
Flexibility of hamstring ‡	SMR	-0.63	0.52	-1.06, -.19,	5.43	0.03*	.206
	MFD	-1.33	0.71	-1.88, -.79			
Overall muscular strength ‡	SMR	0.00	0.00	0.00, 0.00	3.15	0.10	.112
	MFD	-0.56	0.88	-1.23, .12			
Strength of hamstrings ‡	SMR	-0.13	0.64	-.66, .41	3.15	0.10	.112
	MFD	-0.89	1.05	-1.7, -.08			
Pain in hamstrings ‡	SMR	0.25	0.89	-.49, .99	0.47	0.50	-.032
	MFD	0.67	1.50	-.49, 1.82			
Effect on sport performance ‡	SMR	0.13	0.35	-.17, .42	0.001	0.98	-.06
	MFD	0.11	1.27	-.86, 1.09			
Effect on activities of daily living ‡	SMR	0.00	0.00	0.00, 0.00	2.02	0.18	.056
	MFD	0.22	0.44	-.12, .56			

* indicates statistically significant difference at p<0.05 level.

‡ indicates subjective variables assessed by the Perceived Functional Ability Questionnaire. Subjects rate each variable according how they feel at that moment in time on a scale of 1-10 where Poor= 1-3; Good =4-7; Excellent= 8-10

duration. To assess if changes in ROM satisfied a minimally clinically important difference (MCID) a change score equivalent to the MCID for ROM was calculated using the standard deviation of baseline scores multiplied by a small effect size of 0.2.[51] Using these guidelines the MCID for ROM was calculated to be 3.19°. Thus after a single treatment using either MFD or SMR, the improvements noted in hamstring length may be considered clinically important, and enough improvement in range to positively change patient perception.

It is not surprising that either technique improved ROM as both likely address the fascial component of the myofascial unit, but in different ways mechanically. The skin and fascia are highly responsive structures, which allow them to play a major role in maintaining normal body function.[52] There are several physiological hypotheses as to how soft tissue mobilization works including increased blood flow, increased lymphatic drainage of toxins, reduced tissue stiffness, alteration in neuromuscular activity and a decreased inflammatory response.[53] The fascia also contains mechanoreceptors and smooth muscle receptors that when stimulated may help in lowering the sympathetic tone, leading to tonus changes in muscle.[23]

Luigi Stecco[54] states that fascia is the only tissue that modifies its consistency when under stress (plasticity) and which is capable of regaining its elasticity when subjected to manipulation (malleability). Cupping has the ability to grab and lift the fascia to allow for lymphatic drainage of toxins and more efficient exchange of nutrient rich blood, as well as stretching the fascial tissue.[55] The friction created between the cups and the tissues may cause the fascia to increase in temperature and changes the viscosity of the fascia from a viscous gel to a more fluid like state.[21] Manual therapy techniques treat the fascial layers by altering density, tonus, viscosity, and the arrangement of fascia.[56–58] Purslow reported that the

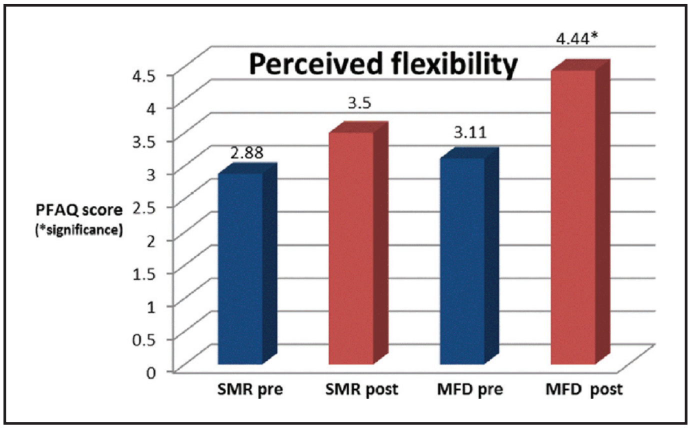

Figure 6. *Subjects' mean perception of flexibility after a single treatment of myofascial* decompression (MFD) and self-myofascial release (SMR).

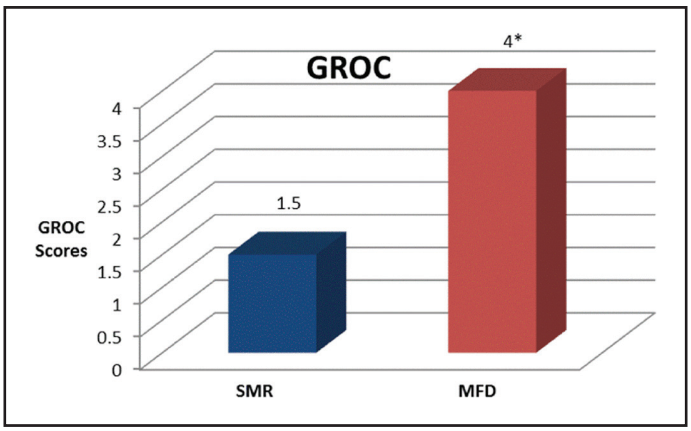

Figure 7. *Subjects' mean scores on the Global Rating of Change (GROC) scale after a single treatment of self-myofascial release (SMR) and myofascial decompression (MFD).*

multidirectional layers of collagen fibers and the architectural arrangement of muscle fibers is a key determinant of muscle tissue properties.[59] Fibrocytes in the fascia respond to mechanical stretch through mechanotranduction[60–62] with collagen fibers providing more resistance to reorientation as the fascia is stretched longitudinally.[63] Thus it is important to utilize a multi-planar strategy to treat the fascial tissues using cupping, or any myofascial manipulation technique.

Foam rolling is mostly longitudinal, as in the case of the current study. However, the circular nature of the cups arranged in a multilinear fashion along the fascial line permits a multi-directional approach to the treatment application perhaps targeting a larger architectural arrangement of the muscle fibers and treating fascial fibers in multiple angles. The static and dynamic nature of the MFD treatment used in this study likely impacts multiple layers of the fascia that lie in a multitude of different directions. The SMR treatment protocol in the current study applied only a longitudinal direction of force applied to the fascia, thus perhaps limiting its effect on mobility. Future studies should investigate the impact of soft tissue mobilization on ROM taking into consideration specific direction of fiber layering in their treatment approach.

Some researchers have suggested potential benefits for pain conditions using cupping.[38] The MFD group in the current study experienced a higher therapeutic effect than SMR as demonstrated by significantly higher score on the GROC scale compared to SMR. Although the average increase of 2.5 scale points between the two interventions was not enough to indicate a clinically meaningful difference in comparison to each other, the difference in four scale points observed in subjects receiving MFD indicates a clinically important change in hamstring flexibility.[45] How a patient feels about their own body or injury is an important aspect of recovery. The GROC scale was utilized in attempt to gain an observable difference between how subjects felt after their treatment in both the MFD and SMR groups. The subjective measure of the GROC scale allows the subject to consider what they feel is important.[44] Subjects in the MFD group indicated they felt "moderately better" after treatment compared to those in the SMR group indicating they felt a "tiny bit better" to a "little bit better". The way a patient cognitively assesses their injury can have an effect on their attitude toward rehabilitation of that injury and the rate of healing.[64]

Just as important are patient perceptions of improved function during treatment. Perceptions of improved flexibility were also noted in both treatment groups, though MFD demonstrated significantly higher perceptions of improved hamstring flexibility compared to SMR. The effect size in this comparison was quite large ($\omega^2 = .206$) indicating a larger effect of MFD on perceived hamstring flexibility. Combined data revealed a large effect size for perceived flexibility of the hamstring overall regardless of treatment ($d = .85$). Effect sizes from the paired t-tests were also considered large effects independently (MFD d = 1.06; SMR d = .61). Weppler and Magnusson suggested that increases in tissue extensibility likely do not from come affecting the mechanical properties of the muscle being stretched but result from changes in the individual's perception of stretch or pain.[65] This is known as the 'sensory theory' and it proposes that increases in muscle extensibility after stretching are due to modified sensation. Changes in fascial length and tension in response to MFD could modify such sensations. Based on the current findings, clinicians can use MFD during a rehabilitation session to decrease a patient's perception of pain or stiffness associated with the soft tissue injury and improve their attitude toward their healing. According to these results, MFD can enhance patient confidence in their physical abilities more so than SMR by the added perceptions of decreased tightness in the affected area, thus allowing for better quality of work in the therapeutic setting.

An interesting observation in this study is that subjects that received MFD indicated a higher perception of strength in the hamstrings after one treatment. Studies have shown through fascial connections, muscle force transmission occurs between adjacent and even antagonistic muscles.[66,67] The results of a systematic review by Cheatham et al. indicate that SMR using either foam rolling or roller massage may have short-term effects of increasing joint ROM without decreasing muscle performance.[68] While changes in muscle force production were not tested in the current study, subjects indicated that they felt stronger in the treatment area after MFD compared to SMR using a foam roller. Actual changes in muscular output should be investigated in future studies to see if strength is affected in any way after this technique is applied, or if acute strength deficits occur as has been observed with static stretching.[69-72]

While the outcomes of MFD may be considered clinically relevant, there were limitations to this study. It could be argued the treatments were provided at sub-therapeutic doses and the interventions could be more effective if treatment dose were maximized. At this point, there is no research guiding the appropriate dosage of MFD and more research should be done in this area. Participants were blinded to the ROM outcome measure, but not blinded to the treatment they received. This could have introduced some bias in their subjective responses of the patient-oriented outcome scales as patients are more likely to have experienced or used a foam roller than a novel application of a cupping treatment. The present study also did not control for force application of the foam rolling and subjects may not have exerted enough pressure to affect the soft tissue for an accurate comparison.

The lack of a control group, or sham intervention may have introduced bias in the study results by creating a placebo effect. Subject bias can take place by the mere attention and contact provided by the researchers, and without a true control group study design absolute results are uncertain. There is currently no sham intervention for MFD so another common soft tissue treatment for hamstring injuries was selected. Finally, the small subject pool experiencing the selected pathology may not have fully represented hamstring pathology patients. The small number of individuals meeting the inclusionary criteria of the study limited the ability to add an additional treatment group (control); therefore, multisite clinical studies may be necessary to meet these criteria. Large scale randomized clinical trial research is needed to further investigate the evidence of MFD in the treatment of musculoskeletal pathologies. Given the positive acute outcomes associated with this study, future research is warranted to further investigate the immediate and long-term outcomes associated with this therapy. Long-term follow-up results are needed to assess the full effectiveness and lasting action of MFD on hamstring flexibility and function.

CONCLUSIONS

The results of this study indicate that both MFD and SMR are beneficial in making an acute clinically relevant difference in hamstring flexibility after a single treatment in patients with complaints of hamstring pathology symptoms. Myofascial decompression appeared superior to heat and SMR application and can be used as an effective treatment modality to address limitations in hamstring flexibility. Subjective data from the patient-oriented outcome measures were positive showing that MFD has a strong effect on perceptions of overall flexibility, and flexibility of the targeted treatment area. Patient self-reports indicated a moderate effect on perceived strength improvement and perceptions of feeling better after a single treatment of MFD to the hamstrings. Additional research is needed to further investigate clinical outcomes of this contemporary and increasingly common treatment modality. Other factors including changes in muscular function and strength should be investigated in future studies. Because hamstring pathology is prevalent in sport there is a need to identify best practices in the prevention and treatment of injury to this muscle group.

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